Benefits to the National Oceanic and Atmospheric Administration of Co-location with the University of Oklahoma

Co-location of the National Oceanic and Atmospheric Administration (NOAA) elements with the University of Oklahoma (OU) will strengthen and extend a unique, synergistic government-university partnership wherein resources and expertise in the University will significantly augment (double the resources) of our NOAA programs. NOAA will also gain from its access to the academic communities unique facilities (e.g., Mesonet, Supercomputers, Calibration Lab, etc.)

In an era of reduced funding to support research and facilities, it has become very important to build collaborative relationships in order to accomplish our research and maintain the first-class NOAA services our Nation has come to expect. In addition, the operational elements (Storm Prediction Center (SPC), Operational Support Facility (OSF) and Weather Forecast Office (WFO)) have been reduced in staffing during the NWS modernization and no longer have the capacity to engage independently in extensive research and development activities. While some of these needs are being met by the co-location with the National Severe Storms Laboratory (NSSL), NSSL has been level funded for many years and in real dollars is losing its capability to meet the operational research and development needs as stated in the NOAA strategic plan. Co-location allows for easy access to research faculty and students who help to augment NOAA staff and reduce the effects of these resource reductions. In addition, co-location improves the technology transfer process making it more timely and improving the quality of the end product.

Our vision of a new building housing both OU and NOAA components provides an environment that:

- encourages scientific discussion among faculty, students, and NOAA staff in an informal and open setting, while facilitating a research environment.

- frames basic research and development within the backdrop of operational applications.

- places theoretical, computational, field, and laboratory investigations under the same roof as operational forecasters.

- creates a greater sense of educational training and purpose among students via frequent interactions with scientists and forecasters.

- provides advanced facilities for training, teaching, and research.

- reduces the time to transfer technology from research to operations.

- serves as a model of the benefits of having research, education, and operations in one facility for the state, Nation and world.

-creates an environment where operational forecasters can provide the benefit of their

experience to the people tasked with providing forecasts to field experiments.

-creates an environment where operational forecasters can provide research meteorologists with real-time examples of the various problems that they face.

-allows students to gain operational experience by being part time volunteers at the SPC and WFO.

-allows students to gain research experience by being part time employees/volunteers at the NSSL.

-enables forecasters to purse advanced meteorological course work.

-facilitates numerical model developers by allowing real-time feedback from operational users resulting in improved product development.

-allows students to gain operational knowledge by participating in the operational map discussions.

-allows forecasters to attend university seminars.

-allows university scientists to participate in operational workshops sponsored by the SPC and/or the WFO.

BENEFITS ANALYSIS:

1. Access to expertise at OU:

By locating NOAA's components with the meteorological components of the University of Oklahoma, NOAA leverages the OU staff and resources to work on NOAA problems. Two excellent examples of co-locating NOAA components with a university were recently reported to the National Weather Service (NWS) Director, Jack Kelly by Louis Uccellini, the National Centers for Evironmental Prediction (NCEP) Director in the attached April 29, 1999 letter. In the letter, Dr. Uccellini describes the "value" of synergistic interactions fostered by the co-location of operational forecast units and institutions. Co-location of the Raleigh-Durham and Albany forecast offices with local Universities has led to dramatic improvements in Probability of Detection and reduced False Alarm Rates as a result of forecast and warning improvements at these offices. These collaborative activities and increased forecasting skill is helping meet the preformance measures as outlined in the NOAA strategic plan.

Collocation with OU allows operational forecasters and research meteorologists to work side-by-side during field programs. The value of these type interactions is illustrated by the Verification of the Origins of Rotation in Tornadoes experiment (VORTEX (1994, 1995)) and the Mesoscale Convective Systems (MCS) Electrification and Polarimetric Radar Studies (MeaPRS (1998)) field programs. The VORTEX effort studied the operationally critical relationships between Convective Available Potential Energy (CAPE), Convective Inhibition (CIN), Helicity (a measure

of a storms potential to rotate), rotating supercells and tornado genesis. The operational impact of this effort is reflected in the steady rise in SPC skill at forecasting "significant" severe thunderstorm events.

The VORTEX results illustrate another positive aspect of operational forecasters participating in collaborative projects. The meteorological research community works on the premise that it takes seven years for research results to propagate from a field program through publication to operational implementation. However, forecasters who were active participants in an experiment will use techniques that were helpful during the field program in their operational forecasts even if they have not been formally published. This circumvents the "seven-year cycle." Formal publication is still needed so that forecast techniques are presented to the entire community, but the payback can begin much sooner with an integrated, collaborative approach faciliated by co-location. This was the case of the helicity, CAPE, CIN results.

Similar performance improvements would also result from the Norman WFO and SPC co-location with OU. While it is hard to quantify the exact value of this relationship, these improvements save lives and property by providing increased warning lead times and accuracy.

A review of the American Meteorological Society (AMS) and the University Center for Atmospheric Research's (UCAR) report "1998 Curricula in the Atmospheric, Oceanic, Hydrologic, and related Sciences", indicates that nearly all of OU's meteorological, hydrological and climatological research is important to NOAA. To estimate the value of OU's expertise to NOAA, consider the fact that conservatively 80% of that research directly relates to the types of problems that are important to NOAA's mission and OU has approximately 200 faculty, research scientists, research associates and graduate students (Meteorological faculty are required to teach 25% of their time, leaving the rest available for research, academic committees, etc.) Assume that of these 200 personnel, conservatively 50% of their time is devoted to research. This would result in approximately 80 staff/student years spent annually working on NOAA related problems. If the cost per staff year is an average of $60K, then NOAA would obtain the equivalent of $4.8M per year in research at no cost. In addition, OU averages over $10M per year in externally funded research. If only 50% of this research is directed at NOAA problems, then $5M extra resources would be devoted to solving our problems. Thus, in 20 years, NOAA would have benefitted from between $96M and $196M of research because of the co-location with the University. Being very conservative, if only 25% of their time was devoted to research and if only 50% of the research was important to NOAA, this would still result in $30M to $130M benefit over 20 years.

2. Access to unique facilities:

a. Mesonet: The state of Oklahoma has established a 154 station Mesonet throughout the state. Although NOAA has benefitted from the use of the mesonet data in producing their forecasts, NOAA has chosen not to provide funding to supplement the support of this mesoscale observing system. Due to the close relationship of the NOAA components to the Oklahoma Climate Survey, NOAA's access to this data has been free. By maintaining this close relationship and enhancing it through co-location, other similar projects could benefit NOAA. The annual cost to purchase the mesonet data is $100K and that equates to $2M over 20 years.

b. Super Computing: In order to meet the goals of NOAA's Strategic plan, NSSL

researchers have a need for access to supercomputing. One of the biggest problems in working with supercomputers is access to the databases required to initialize model runs. Being co-located with the OU supercomputers would solve this problem and provide free to minimum cost access to supercomputing. Cost savings to NOAA per year would be $50K and that equates to $1M over 20 years.

c. Calibration Laboratory: The NSSL requires the use of a calibration facility to support the equipment used in the operation of its mobile laboratories. If co-located with OU, NOAA (NSSL) would not have to build their own calibration facility where the cost of the equipment alone is $100K. The annual cost of personnel with expertise to run the calibration facility is $100K per year. This equates to a cost savings of $2M over 20 years.

d. Very High Speed Networking: Being co-located with OU gives the NOAA components access to Internet II with a cost savings of $150K per year equating to $3M over 20 years.

e. Distance Learning Center: Co-location would provide NOAA with access to a planned state-of-the-art distant learning center. The cost of a high-tech studio is over a million dollars. In addition, a combined center would result in lower communication costs and provide access to staff for development of new technologies for distance learning and associated risk reduction studies. This could result in improved training for NWS forecasters that might not otherwise be affordable. Although detailed estimates of the savings to be realized are not available, the cost of the studio alone could result in an estimated savings of $1M or more over 20 years.

f. Facilities Sharing: NOAA has a need for certain facilities, such as conference rooms and an observation area along with improved facilities such as a library, cafeteria, Joint Mobile Research Facilities, etc.. Actual cost savings are hard to quantify without identifying the square footage involved but certainly the reduction in space requirements for these functions would result in savings to NOAA.

3. Opportunities lost based on not being co-located:

Over the years, NOAA has had many opportunities to work closely with OU. It is the collective opinion of the members of the Oklahoma Weather Center (comprised of the Directors of the NOAA and OU meteorological components), that during this time many projects would have been much more successful if the NOAA and OU meteorological components had been co-located in the same facility. Some examples are: development of the Advanced Regional Prediction System (ARPS) model and its transfer to the NWS; creation of a Natural Hazards Research Center; development of a prototype of regional collection and distribution of WSR-88D level II data; expansion of OK-First nationally; implementation of numerical forecasting and analyses into Weather Decision and Support Systems; creation of a knowledge based and distributed intelligence effort; management of the Joint Mobile Research Facility; comprehensive studies of severe weather outbreaks (May 3, 1999 - Oklahoma Tornado outbreak); and research into short-range and storm-scale ensemble forecasting.

Additional projects that could fall into this category are making ARPS a part of the next operational model at NCEP, developing dual-polarization for NEXRAD, phased-array radar development, hydrological studies, a new science and technology center for regional/mesoscale climate, economic and societal impacts, operational testing of short-term NWP, prototype real-time WSR-88D Level II ingest and processing , distant learning and commercialization of technology. These missed opportunities or near misses are hard to quantify, but have resulted in real losses of both lives and property due to slowed developments in improved warnings and forecasts.

4. Future Opportunities:

Co-locating NOAA research and operational activities in Norman with OU will facilitate collaborative efforts for the many future opportunities to advance the science of meteorology and lead to improvements in NOAA's services. These include: a National Numerical Weather Prediction (NWP) test facility for all scales of models; development of a coupled hydro-meteorological models using soil moisture initialization; real-time storm-scale prediction; national collection and redistribution of real-time WSR-88D data; training classes for NWS's WFO and SPC personnel; and joint supercomputing and four-dimensional data assimilation systems as well as many of the projects listed above. Again, it is hard to estimate a value for each and every project and what they might be worth if completed and implemented successfully. Clearly all the projects mentioned above would benefit from co-location and all are important to NOAA's future. If we can improve the environment that produces our best science and this in turn leads to better warnings and forecasts, then NOAA ought to take the opportunity to build the most conducive environment possible for producing the best scientific results.

CONCLUSION:

This is a once in a lifetime opportunity to co-locate NOAA research and operational components with a university conducting related research and development activities. The new facility to be built on the OU South Campus provides a unique privilege to establish a world class center of mesoscale excellence. In the words of the Independent Review Panel, who visited Norman and reviewed the Norman Project, "The Panel sees strong potential benefits for the South Campus consolidation that is worth an economic premium. The benefits to the nation are financial savings, enhanced scientific productivity and technology transfer." "The Panel believes that both NOAA and OU have an extraordinary opportunity of creating an exceptional University/Government partnership.

Using the economic analysis above, NOAA will benefit from between $30M to $205M over 20 years (Table 1 and 2). The estimated increase in cost to co-locate with OU on South Campus verse not co-locating with OU and building on North Campus is estimated at $3.8M. Therefore, the break even point is between 4.5 months and 30 months.

Based on this limited and conservative economic analysis and all the positive non-tangible benefits, the recommendation is to co-locate with OU on South Campus.

TABLE 1. Conservative Identifiable benefits to NOAA of co-location on South Campus

over a 20 year period

	ITEM	BENEFIT (in Millions)
1	OU EXPERTISE	$96
2	OU Externally Funded Research	$100
3	Mesonet	$2
4	Super Computing	$1
5	Calibration Laboratory	$2
6	Very High Speed Networking	$3
7	Distance Learning Center	$1
8	Facilities Sharing	?
	TOTAL	$205

TABLE 2 Very Conservative Identifiable benefits to NOAA of co-location on South Campus over a 20 year period

	ITEM	BENEFIT (in Millions)
1	OU EXPERTISE	$30
2	OU Externally Funded Research	?
3	Mesonet	?
4	Super Computing	?
5	Calibration Laboratory	?
6	Very High Speed Networking	?
7	Distance Learning Center	?
8	Facilities Sharing	?
	TOTAL	$30